REMARKS

Applicants request favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

Claims 25 through 52 are now presented for examination. Claims 25, 37, 49, 50, 51 and 52 have been amended to define still more clearly what Applicants regard as their invention, in terms which distinguish over the art of record. Claims 25, 37, 49, 50, 51 and 52 are the only independent claims.

Claims 25-52 have been rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor at the time the application was filed had possession of the claimed invention In particular, the Examiner asserts that the disclosure at lines 13 through 20 of page 12 of "Although in the example of this embodiment, the present invention is applied to an exposure optical system used in the atmosphere, the present invention is also applicable to an exposure apparatus using EUV or X-rays. In that case, the present invention is more effective, because exposure is performed in a vacuum, and a natural radiation effect is reduced more, as compared with a case in which the exposure is performed in the atmosphere." is an ambiguous statement and does not adequately support the claimed provision of "projection optical system including a diaphragm arranged in a vacuum".

Claims 25-52 have been rejected under 35 U.S.C. § 112, second paragraph, as indefinite in that the Examiner considers the provision in Claims 25, 37 and 49-52 of "projection optical system including a diaphragm arranged in a vacuum" vague and indefinite. With regard

to the claims as currently amended, the rejections under 35 U.S.C. § 112, first and second paragraphs are respectfully traversed.

As currently amended, Claim 25 recites "a projection optical system which projects a pattern of a first object onto a second object by using the X-rays passing through the vacuum, said projection optical system including a diaphragm irradiated by the X-rays, and a cooling device which cools said diaphragm.. This recitation of Claim 25 corresponds to the disclosure at lines 13 through 20 of page 12 in the specification and clearly recites the arrangement of the the X-rays, the diaphragm and the cooling device with respect to the vacuum as disclosed in the specification. Claims 37 and 49-52 have been similarly amended. Accordingly, it is believed that Claims 25-52 as currently amended fully meet the requirements of 35 U.S.C. § 112, first and second paragraphs.

Claims 49-52 have been rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 5,530,518 (Ushida et al.) in view of U.S. Patent 6,020,950 (Shiraishi et al.) and further in view of U.S. Patent 5,142,148 (Sato). With regard to the claims as currently amended, this rejection is respectfully traversed.

Independent Claim 49 as currently amended is directed to exposure apparatus that performs exposure using EUV in a vacuum. In the apparatus, a projection optical system projects a pattern of a first object onto a second object by using the EUV passing through the vacuum during exposure. The projection optical system has a diaphragm irradiated by the EUV and a cooling device which cools the diaphragm through a heat removal path joined to the diaphragm.

Independent Claim 50 as currently amended is directed to a device manufacturing method in which exposure of a pattern of a reticle onto a wafer is performed in a vacuum by projecting EUV through the vacuum. A diaphragm of a projection optical system is irradiated by the EUV. The diaphragm is cooled during the exposure through a cooling device having a heat removal path joined to the diaphragm. A device is manufactured from the wafer.

Independent Claim 51 as currently amended is directed to exposure apparatus that performs exposure using EUV in a vacuum. In the apparatus, a projection optical system projects a pattern ofa first object onto a second object using the EUV passing through the vacuum during exposure. The projection optical system has a diaphragm irradiated by the EUV and a cooling device which cools the diaphragm. A sensor that detects temperature information of the diaphragm is located on the diaphragm at a position not being irradiated with the EUV.

Independent Claim 52 as currently amended is directed to a device manufacturing method in which exposure of a pattern of a reticle onto a wafer by is performed by projecting EUV through the vacuum. A diaphragm of a projection optical system is irradiated by the EUV. The diaphragm is cooled through a cooling device having a heat removal path joined to the diaphragm. Temperature information of the diaphragm is detected with a sensor provided on the diaphragm at a location not being irradiated with the EUV. A device is manufactured from the wafer.

In Applicants' view, Ushida et al. discloses a projection exposure apparatus that includes an illuminating optical device for illuminating a projection negative and a projection optical device that projection-exposes a projection negative illuminated by the illumination

optical device onto a substrate. The illuminating optical device includes a light source that supplies exposure light, an annular light source that forms an annular secondary light source by light from the light source and a condenser that condenses the light beam from the annular light source on the projection negative.

In Applicants' opinion, Shiraishi et al. '950 discloses an exposure method and projection exposure apparatus in which a light shielding plate has a set of fixed peripheral openings with a fluid path through the center of the plate.

Sato, in Applicants' view, discloses a field emission scanning electron microscope in which an aperture plate is disposed in a high-vacuum region between an accelerating electrode and a condenser lens. The probe current is controlled by controlling an extracting voltage applied to an extracting electrode. An aperture plate 4 that controls an electron beam diameter is protected against contamination due to electron beam illumination by placing it under a high vacuum as an alternative to a heating arrangement for cleaning the aperture plate.

According to the invention of Claims 49 and 51 as currently amended, a projection optical system projects a pattern of a first object onto a second object using the EUV passing through a vacuum during exposure and the projection optical system includes a diaphragm irradiated by the EUV and a cooling device which cools said diaphragm through a heat removal path joined to the diaphragm. In Claims 50 and 52 as currently amended, exposure of a pattern of a reticle onto a wafer is performed in a vacuum by projecting EUV through the vacuum and a diaphragm of a projection optical system is irradiated by the EUV. The diaphragm

is cooled during exposure through a cooling device having a heat removal path joined to the diaphragm.

Ushida et al. may teach a projection optical system that projects a pattern of a reticle onto a substrate and has an aperture controlling diaphragm. Shirashi et al. may teach a cooling member for a light shielding plate. Neither Ushida et al. nor Shiraishi et al. in any manner teaches or suggests a projection optical system that uses EUV which passes through a vacuum during exposure or has a diaphragm irradiated by the EUV passing through the vacuum.

Sato may disclose an aperture plate 4 irradiated by an electron beam in a high vacuum for the sole purpose of reducing contamination. The Sato disclosure, however, is devoid of any suggestion of a cooling device for the diaphragm of a projection optical system operating in a vacuum that is irradiated by EUV and has a cooling device joined thereto. Accordingly, it is not seen that the addition of Sato et al.'s electron beam irradiation of an aperture plate in a vacuum for contamination reduction to the cooling of a light shielding plate of Shiraishi without being irradiated by EUV passing through a vacuum combined with Ushida et al.'s pattern projection from a reticle to a substrate devoid of using EUV passing through a vacuum could possibly suggest the features of Claims 49 through 52.

It is a further feature of Claims 51 and 52 that a sensor which detects temperature information of the diaphragm is located on the diaphragm at a position not being irradiated by the EUV. Neither Ushida et al. nor Sato in any manner suggests a temperature detecting sensor on a diaphragm. Shiraishi et al. only teaches a cooler CL remote from a light shielding plate FL that supplies a cooling fluid to the light shielding plate but is devoid of any

suggestion of a temperature detecting sensor on the light shielding plate. As a result, it is not seen that any combination of Ushida et al., Shiraishi et al. and Sato suggests the temperature sensing features of Claims 51 and 52. In at least the foregoing respects, Claims 49 through 52 as currently amended are believed to be completely distinguished from any combination of Ushida et al., Shiraishi et al. and Sato and allowable.

Claims 25-48 have been rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 4,475,223 (Taniguchi et al.) in view of Ushida et al. and further in view of Shiraishi et al. and further in view of Sato. Claims 34, 35, 46 and 47 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Ushida et al. in view of Shiraishi et al. and further in view of Sato and further in view of previously cited U.S. Patent 5,894,341 (Nishi et al.). With regard to the claims as currently amended, these rejections are respectfully traversed.

Independent Claim 25 as currently amended is directed to exposure apparatus that performs exposure using X-rays in a vacuum. In the apparatus, a projection optical system projects a pattern of a first object onto a second object by using the X-rays passing through the vacuum. The projection optical system has a diaphragm irradiated by X-rays and a cooling device which cools the diaphragm.

Independent Claim 37 as currently amended is directed to a device manufacturing method in which exposure of a pattern of a reticle onto a wafer is performed in a vacuum by projecting X-rays through the vacuum. A diaphragm of a projection optical system is irradiated by the X-rays. The diaphragm is cooled during the exposure and a device is manufactured from the wafer.

In Applicants' view, Taniguchi et al. discloses An X ray exposure process and system for transferring a mask pattern onto a wafer with use of X rays in which heights on the mask at many points are measured on a light interference band basis by a mask-height measuring device of non-contact measurement type at an X ray exposure position. The mask is mounted on a chamber which is filled with a He gas and or the like to prevent attenuation of an X ray source. Heights on the wafer at many points are measured at a wafer-height measuring position different from said exposure position, and according to the measured results, the wafer is finely moved upwardly or downwardly (that is, deformed) individually independently by means of a chuck which sucks and holds the wafer at many points thereon so that, a gap between the mask and wafer is adjusted to a desired level.

It is a feature of Claims 25 and 37 as currently amended that a projection optical system which projects a pattern from a first object (reticle) to a second object (wafer) uses X-rays passing through a vacuum in which a diaphragm of the projection optical system is irradiated by the X-rays. Taniguchi et al. may teach generating X-rays for exposure in a vacuum chamber 2 by emitting electron beams 4 from an electron gun 3 directed at a target 5 from which X-rays 6 are emitted. The X-rays are then directed through a helium filled chamber 51 to a mask 10. The X-rays from the mask pattern are then directed to a wafer 11 outside the helium filled chamber. Accordingly, it is not seen that Taniguchi et al.'s generation of X-rays in a vacuum chamber, passage through a helium filled chamber to a mask and then passage outside a vacuum to a wafer in any manner teaches or suggests the feature of Claim 25 of projecting a pattern of a first object onto a second object by using X-rays passing though a vacuum or the feature of Claim

37 of performing exposure in a vacuum of a pattern of a reticle onto a wafer by projecting X-rays through the vacuum.

As discussed with respect to Claims 49-52, neither Ushida et al. nor Shiraishi et al. teaches or suggests a projection optical system that uses X-rays passing though a vacuum and that the projection optical system includes a diaphragm irradiated by the X-rays. Sato only teaches an aperture plate 4 irradiated by an electron beam in a high vacuum to reduce contamination as a replacement for a heater for contamination reduction but fails to teach or suggest in any manner a diaphragm of a projection optical system that is irradiated by X-rays as in proposed Claims 25 and 37. Accordingly, it is not seen that adding the cited combination of Ushida et al., Shiraishi et al. and Sato to Taniguchi et al.'s X-ray passage through a helium filled chamber to a mask and then to a wafer outside the helium filled chamber could suggest the features of Claims 25 and 37. It is therefore believed that Claims 25 and 37 as currently amended are completely distinguished from any combination of Taniguchi et al., Ushida et al., Shiraishi et al. and Sato and are allowable.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record. Applicants submit that the amendments to independent Claims 25, 37 and 49 through 52 clarify Applicants' invention and serve to reduce any issues for appeal.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same

reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration, of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application. The Examiner is respectfully requested to enter this Amendment After Final Action under 37 C.F.R. § 1.116.

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